

What is Claimed is:

- 1 1. An iron oxyhydroxide material capable of intercalating lithium ions composed  
2 of nanometer-sized iron oxyhydroxide particles with short-range-order structures.
- 1 2. The iron oxyhydroxide material of claim 1, wherein the lithium ion intercalating  
2 capacity is at least 0.5 moles of lithium ions per mole of iron oxyhydroxide.
- 1 3. The iron oxyhydroxide material of claim 1, wherein the lithium ion intercalating  
2 capacity is at least 1.0 moles of lithium ions per mole of iron oxyhydroxide.
- 1 4. The iron oxyhydroxide material of Claim 1, wherein the particles are less than  
2 100 nm in size.
- 1 5. The iron oxyhydroxide material of Claim 1, wherein the particles are about 30  
2 nm in size.
- 1 6. The iron oxyhydroxide material of Claim 1, wherein the iron oxyhydroxide has  
2 a short-range-order structure, weakly resembling the phase  $\alpha$ -FeOOH or *goethite*.
- 1 7. The iron oxyhydroxide of claim 1, wherein the chemical composition of the  
2 compound is  $\text{Na}_x\text{Fe}(\text{OOH})_y$ , for  $0 \leq x \leq 0.25$  and  $0.9 \leq y \leq 1.33$ .

- 1 8. The iron oxyhydroxide material of Claim 1, wherein the iron oxyhydroxide  
2 particles exhibit high porosity.
- 1 9. The iron oxyhydroxide material of Claim 8, wherein the particles exhibit a  
2 Brunauer-Emmett-Teller specific surface area of at least 200 m<sup>2</sup>/g.
- 1 10. The iron oxyhydroxide material of Claim 1, further comprising a specific  
2 capacity of at least 80 mAh/g at a rate of 0.53mA/cm<sup>2</sup>.
- 1 11. The iron oxyhydroxide material of Claim 1, further comprising a specific  
2 capacity of at least 215 mAh/g at a rate of 0.53mA/cm<sup>2</sup>.
- 1 12. The iron oxyhydroxide material of Claim 1, comprising an energy storage  
2 capacity of at least 400 mWh/g at a rate of 0.53mA/cm<sup>2</sup>.
- 1 13. The iron oxyhydroxide material of Claim 1, comprising an energy storage  
2 capacity of at least 525 mWh/g at a rate of 0.53mA/cm<sup>2</sup>.
- 1 14. A method for preparing an iron oxyhydroxide material capable of intercalating  
2 lithium ions, comprising the steps of:  
3 oxidizing Fe(II) via hydrolysis to yield FeOOH; and  
4 dehydrating FeOOH at a temperature and for a time sufficient to yield at least  
5 substantially amorphous nanometer-size particles of FeOOH.

- 1 15. The method of Claim 14, wherein said oxidizing step further comprises mixing  
2 an aqueous solution of Fe (II) with a mixture containing NaOCl and NaOH at ambient  
3 temperature to yield a reaction mixture.
- 1 16. The method of Claim 15, wherein the molar ratio of Fe(II):NaOCl:NaOH  
2 ranges from 1:1.5:5 to 1:5:5.
- 1 17. The method of Claim 15, wherein the molar ratio of Fe(II):NaOCl:NaOH is  
2 about 1:2.5:5.
- 1 18. The method of Claim 15, further comprising stirring the reaction mixture for  
2 about 1.5 hours, and settling the reaction mixture for about 24 hours.
- 1 19. The method of Claim 17, further comprising dialyzing the reaction mixture for  
2 about 5 days through low-pass dialysis films in deionized water to yield a dialyzed  
3 material.
- 1 20. The method of Claim 19, further comprising centrifuging the dialyzed material,  
2 and freeze drying the centrifuged and dialyzed material to yield nanometer-sized  
3 powders.
- 1 21. The method of Claim 14, wherein Fe(II) is selected from the group consisting  
2 of FeCl<sub>2</sub>, Fe(NO<sub>3</sub>)<sub>2</sub>, and Fe(CH<sub>3</sub>COO)<sub>2</sub>.

- 1 22. The method of Claim 14, wherein the dehydrating step further comprises
- 2 heating FeOOH to a temperature of up to 80°C in ambient air for about 24 hours.
  
- 1 23. An iron oxyhydroxide material prepared by the method of claim 14.